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Turkish truffles 2: eight new records from Anatolia

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Abstract—Eight truffle taxa are identified as new records for Turkey: two representing *Ascomycota* (*Tuber ferrugineum*, *Tuber puberulum*) and six representing *Basidiomycota* (*Hymenogaster rehsteineri*, *Hysterangium calcareum*, *Leucophleps aculeatispora*, *Melanogaster macrosporus*, *Sclerogaster compactus*, *Sclerogaster hysterangioides*). We also report new localities within Turkey for *Tuber borchii* and *Melanogaster ambiguus*.

Key words—hypogeous fungi, biodiversity, mycota, taxonomy

Introduction

Turkey is among the more botanically rich regions in the northern hemisphere due to diverse elevation gradients and the convergence of three phytogeographical regions: the Euro-Siberian, Mediterranean, and Irano-Turanian (Castellano & Türkoğlu 2012; Türkoğlu & Castellano 2013; Türkoğlu & Castellano 2014). In temperate to subtropical regions, the level of botanical diversity frequently parallels ectomycorrhizal fungal biodiversity including many truffle species. The most common tree families in much of Turkey are predominantly ectomycorrhizal; these include *Betulaceae, Fagaceae, Pinaceae*, and *Salicaceae*. Moreover, many plantations of introduced *Eucalyptus* (*Myrtaceae*) serve as ectomycorrhizal hosts to diverse introduced truffle

species. *Cistaceae* are dominant understory shrubs in Turkish forests and form ectomycorrhiza-like mutualisms with truffle genera including *Terfezia* (Díez et al. 2002, Castellano & Türkoğlu 2012). Sixty truffle taxa have been reported from Turkey (Solak et al. 2007; Sesli & Denchev 2014; Castellano & Türkoğlu 2012; Türkoğlu & Castellano 2013, 2014; Türkoğlu et al. 2015). Here we present eight truffle species identified as new records for Turkey (one each from *Hymenogaster, Hysterangium, Leucophleps,* and *Melanogaster* and two each from *Sclerogaster* and *Tuber*). We also present new localities for the previously reported *Tuber borchii* and *Melanogaster ambiguus*. The biotic and abiotic factors present in Turkey provide ideal habitat for hypogeous fungal diversity; continued study will likely reveal numerous additional taxa.

Materials & methods

Fieldwork was conducted in the Aegean (Aydın, Denizli, Muğla), Black Sea (Artvin, Bolu, Kastamonu, Ordu, Trabzon), Marmara (Tekirdağ, Yalova), and Mediterranean (Antalya, Burdur) regions of Turkey. Specimens were found by raking the soil and carefully examining the exposed area for fruiting bodies (Castellano et al. 2004). The collections were photographed while fresh, and fresh macromorphological features were described (color, shape, size, bruising reactions, odor, and taste). Specimens were then dried and assigned herbarium numbers for further study. Microscope slide mounts were prepared by rehydrating dried material in 3% KOH, Melzer's reagent, or H_2O. Diagnostic micromorphological characteristics were described and photographed by compound microscopy. All collections were given collector (AT–Aziz Türkoğlu) numbers and are deposited in the Truffle Application and Research Center (TARC) of Muğla Sıtkı Koçman University. Fungal names follow Index Fungorum (2014) and MycoBank (2014) and nomenclatural authorities follow Kirk & Ansell (1992).

Taxonomy

Tuberaceae

Tuber borchii Vittad., Monogr. Tuberac. 44, 1831. Fig. 1

Ascocarp subglobose to irregular, 0.5 × 2.5 cm, surface dry, glabrous, occasionally cracked at maturity, paler when young, darkening to brown, rarely with red-brown patches in furrows at basal portion of fruiting body at maturity. Gleba grey when young, becoming dark brown with maturity, marbled throughout with irregularly branching white veins ≤2 mm wide that frequently originate at the peridium; with maturation asci becoming visible with a hand lens as small brown spheres scattered throughout fertile portions of the gleba; odour rich, sweet, strong. Peridium 140–260 µm thick, hyaline, two-layered: outer layer 45–70(–180) µm thick, red-brown, a densely interwoven layer of pigmented cells 6–23 × 8–28 µm, the walls ±1 µm thick, dermatocystidia

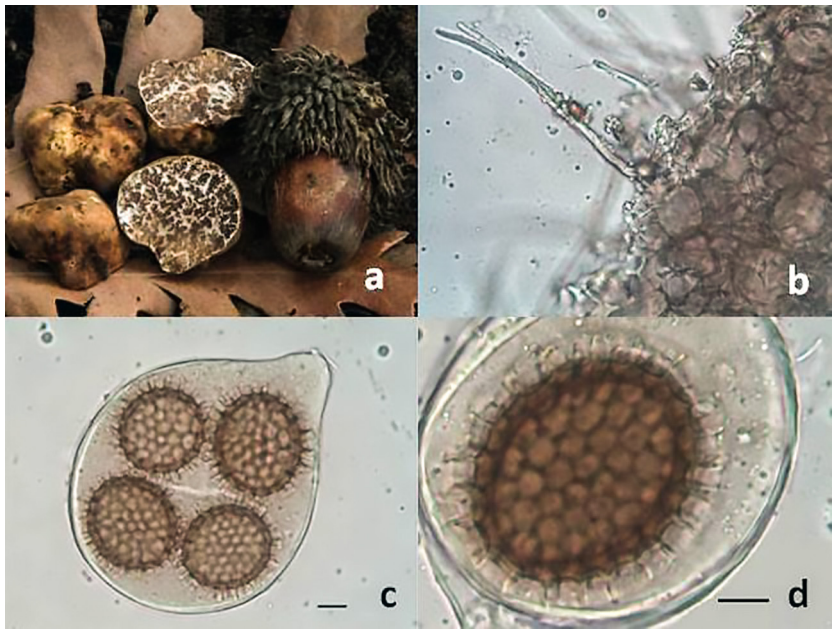

Figure 1. *Tuber borchii* (TARC AT-2253):
a. ascocarp; b. peridium; c. ascus; d. ascospore. Scale bars: c, d = 10 µm.

occasionally present, 64–130 × 4–8 µm wide at base and gradually tapering towards apex; inner layer 130–200 µm thick, of translucent, densely packed inflated cells 6–28 × 8–32 µm, cell walls ±1 µm thick, occasional non-inflated hyphae intermixed. Gleba of tightly interwoven hyphae, 4–13 µm diam, the walls ±1 µm thick, containing scattered oil droplets. Asci subglobose to ellipsoid, 76–99 × 63–85 µm, excluding a stalk ≤18 µm long, tapering towards base, the walls ±1 µm thick, imbedded in the glebal hyphal matrix, 1–4-spored. Ascospores subglobose to ellipsoid, (23–)27–47(–55) × (19–)21–41(–44) µm, mean = 36.6 × 32.4 µm excluding ornamentation [in 1-spored asci 42–55 × 35–42 µm, 2-spored 32–47 × 29–37(–41) µm, 3-spored (23–)26–39(–42) × 21–35 µm, 4-spored 27–37 × 19–31(–33) µm], yellow-brown, ornamentation densely reticulate-alveolate, the alveolae polygonal, 6–10 along the spore axis, red-brown, 4–8 µm tall regardless of spore size.

Specimens examined—**TURKEY, Tekirdağ**, Saray, Ergene district, under mixed stands of *Pinus nigra*, *Quercus* sp., and *Carpinus betulus*, 22 Nov 2013, Türkoğlu AT-2203. **Muğla**, Fethiye, Çenger, under mixed stands of *Quercus cerris, Q. pubescens* and *Pinus brutia,* 9 Mar 2014, Türkoğlu AT-2253; Türkoğlu AT-2266; Fethiye, Gökben,

under *Q. cerris*, 9 Mar 2014, Türkoğlu AT-2258; Ula under mixed stands of *Pinus brutia* and *Quercus coccifera*, 22 Mar 2014, Türkoğlu AT-2296. **Aydın**, Kuşadası, Dilek peninsula, under mixed stands of *Quercus ilex* and *Pinus brutia*, 19 Mar 2014, Türkoğlu AT-2281; Kuyucak, İğdecik, under mixed stands of *Quercus cerris* and *Q. ithaburensis*, 19 Mar 2014, Türkoğlu AT-2286. **Samsun**, Çarşamba, under *Corylus* spp, İsa Şahin, 23 December 2014, Türkoğlu AT-2416.

Remarks—*Tuber borchii* was previously recorded from Kahramanmaraş, Turkey, by Kaya (2009).

Tuber ferrugineum Vittad., Monogr. Tuberac. 46, 1831. Fig. 2

Ascocarp globose to subglobose or irregular, ≤2.2 cm broad, light yellow brown when young, becoming red-brown by maturity, several prominent white furrows present on surface, peridium in cross-section ± 0.1 cm thick, paler in colour than outer surface. Gleba firm, white to pale grey, marbled with irregular white veins, odour pleasant. Peridium 215–390 µm thick, two-layered: outer layer 15–50 µm thick, of red-brown, densely interwoven, pigmented hyphae 1–4 µm broad, the walls ±1 µm thick; inner layer 200–350 µm thick, of translucent,

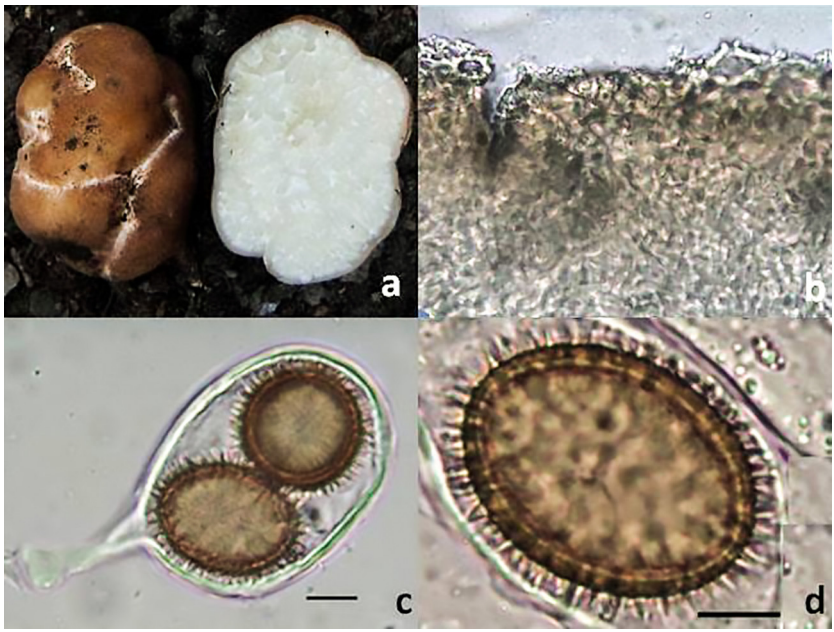

Figure 2. *Tuber ferrugineum* (TARC AT-2279):
a. ascocarp; b. peridium; c. ascus; d. ascospore. Scale bars: c, d = 10 µm.

densely interwoven hyphae 1–4 µm broad, the walls ±1 µm thick, becoming slightly less dense where glebal and peridial hyphae converge. Gleba of hyaline, interwoven hyphae 3–5 µm diam, with infrequent oil droplets, the walls ±1 µm thick. Asci ellipsoid to ovoid, occasionally pyriform, 60–75 × 35–50 µm excluding stalk ≤30 µm long and tapering towards base, the walls ±3 µm thick, embedded in the glebal hyphal matrix, typically 1–4(–5)-spored. Ascospores ellipsoid, 18–43 × 15–29 µm, mean = 28.2 × 20.5 µm excluding ornamentation [in 1-spored asci 29–43 × 21–29 µm, 2-spored 24–37 × 20–26 µm, 3–spored 19–24 × 15–19 µm, 4-spored 21–28 × 15–19 µm, 5-spored 18–23 × 16–19 µm], yellow-brown, densely ornamented with narrow spines 2–4 µm tall.

Specimens examined—**TURKEY, Aydın**, Kuşadası, Dilek peninsula, under mixed stands of *Quercus ilex* and *Pinus brutia*, 19 Mar 2014, Türkoğlu AT-2279. **Muğla,** Campus of Muğla Sıtkı Koçman University, under mixed stands of *Pinus brutia* and *Quercus coccifera*, 30 Apr 2014, Türkoğlu AT-2321. **Denizli**, Serinhisar, Yatağan, under mixed stands of *Pinus brutia, Quercus coccifera* and *Q. ithaburensis*, 8 May 2014, Türkoğlu AT-2332. **Antalya,** Akseki, under *Tilia* sp., 31 May 2014, Esra Er AT-2373.

Tuber puberulum Berk. & Broome. Ann. Mag. Nat. Hist. 18: 81, 1846. Fig. 3

Ascocarp globose to subglobose, ≤0.6 cm tall × 1.5 cm broad, off-white to yellowish becoming pale to yellow-brown, sometimes pale pinkish, surface dry and pubescent. Gleba grey when young, becoming dark brown by maturity, marbled with irregular white veins ≤1 mm broad, originating at the peridium and spreading throughout the gleba, at maturity asci become visible with a hand lens as small brown spheres scattered throughout fertile portions of the gleba. Peridium 110–365 µm thick, white in cross-section, outer edge pale reddish, a single layer of tightly, interwoven hyphae 4–10 µm broad, cell walls ±2 µm thick, with crowded dermatocystidia 5–8 µm wide at base and gradually tapering towards apex, ≤118 µm tall, the walls ±1 µm, emerging from the peridial surface to create a distinctive turf of hyphal tips. Gleba of interwoven hyphae 5–10 µm broad, walls ±1 µm thick, slightly more inflated than those of the peridium, oil droplets frequently present. Asci subglobose to ellipsoid, 65–80 × 65–90 µm, embedded in gleba tissue, typically sessile, the walls ±2 µm thick, 1–4-spored. Ascospores subglobose to ellipsoid, 25–48 × 23–44 µm, mean = 37.6 × 33.1 µm excluding ornamentation [in 1-spored asci 46–48 × 40–44 µm, 2-spored 34–50 × 29–41 µm, 3-spored 25–42 × 23–35 µm, 4-spored 26–35 × 24–29 µm], yellow-brown; ornamentation reticulate-alveolate, meshes polygonal, 6–8(–11) along the axis, red-brown, 5–7 µm tall.

Specimens examined—**TURKEY, Denizli,** Buldan, Süleymanlı, under mixed stands of *Pinus brutia, Quercus cerris* and *Q. ilex*, 17 Dec 2013, Türkoğlu AT-2111; Serinhisar, Yatağan, under mixed stands of *Pinus brutia, Quercus coccifera* and *Q. ithaburensis*,

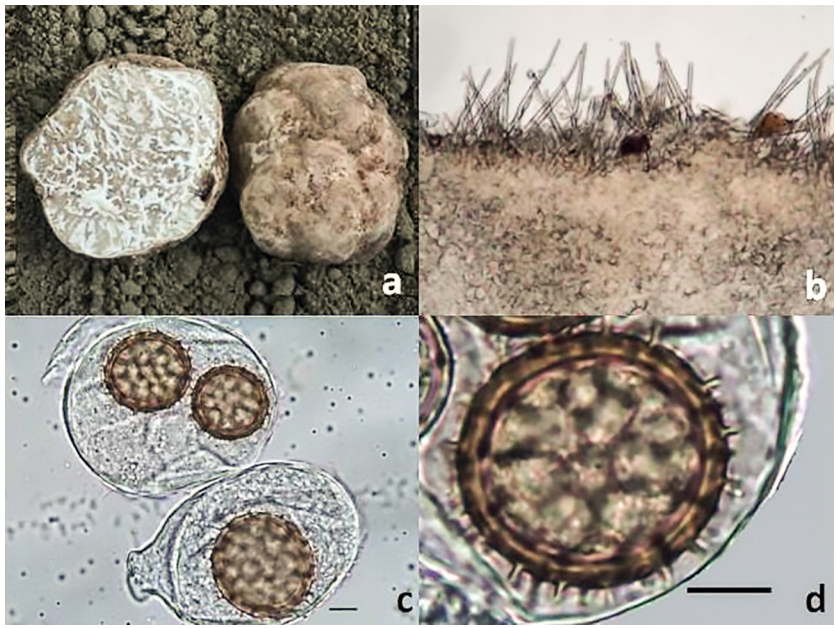

Figure 3. *Tuber puberulum* (TARC AT-2257):
a. ascocarp; b. peridium; c. ascus; d. ascospore. Scale bars: c, d = 10 µm.

21 Mar 2014, Niyazi Uluçoban AT-2294; 8 May 2014, Niyazi Uluçoban AT-2330; Baklan, under *Quercus coccifera* and *Q. trojana*, 18 May 2014, Niyazi Uluçoban AT-2353; Acıpayam, Şahman yaylası *Pinus* spp., and *Quercus* spp., 5 Jun 2014, AT-2388. **Muğla**, Fethiye, Gökben, under *Quercus cerris*, 9 Mar 2014, Türkoğlu AT-2257; Campus of Muğla Sıtkı Koçman University, under mixed stands of *Pinus brutia* and *Quercus coccifera*, 30 Apr 2014, Türkoğlu AT-2322; Dalaman, Çöğmen, 14 Apr 2015, AT-2481; **Aydın**, Kuyucak, İğdecik, under mixed stands of *Quercus cerris* and *Q. ithaburensis*, 19 Mar 2014, Türkoğlu AT-2287. **Osmaniye**, Kaypak köyü, *Pinus* spp. and *Quercus* spp. 27 Apr 2015, Fatih Kaya AT-2491.

Albatrellaceae

Leucophleps aculeatispora Fogel. Can. J. Bot. 57: 1727, 1979. Fig. 4

Basidiocarp irregularly subglobose to lobate, 1.4 × 2 cm, surface at first white to off-white to partly pale yellow becoming yellow-brown, basal mycelia prominent. Gleba white. Peridium 160–220 µm thick, pale yellow to yellow-brown, of loosely interwoven hyphae 2–6 µm broad, the walls ± 1 µm thick. Trama 50–110 µm thick, of hyaline to pale yellow, compactly interwoven hyphae 2–3 µm broad, the walls ± 1 µm thick, droplets scattered within the

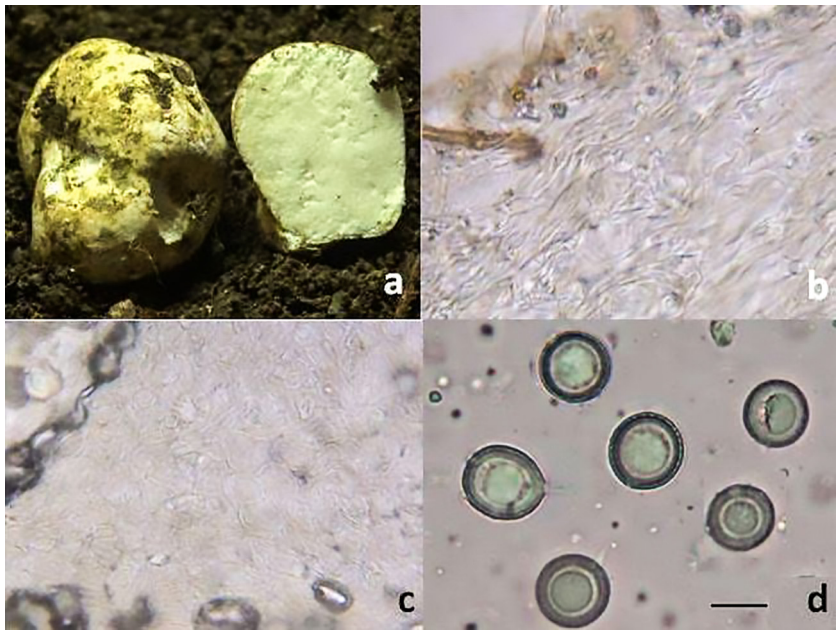

Figure 4. *Leucophleps aculeatispora* (TARC AT-2195):
a. basidiocarp; b. peridium; c. trama; d. basidiospores. Scale bar = 10 µm.

hyphae. Basidia not observed. Spores globose or slightly ovoid, 11.4–13.5 × 11.0–12.7(–13.3) µm, mean 12.6 × 11.8 µm, white, ornamented with crowded, minute spines embedded in a mucilaginous matrix.

Specimens examined—**TURKEY, Kastamonu**, Küre, under *Abies nordmanniana* var. *bornmuelleriana* and *Fagus orientalis*, 11 Nov 2013, Türkoğlu AT-2195; Türkoğlu AT-2196; Türkoğlu AT-2197.

Hysterangiaceae

Hysterangium calcareum R. Hesse, Hypog. Deutschl. 1: 97, 1891. Fig. 5

Basidiocarp globose to subglobose, often lobate, 1 × 1.5 cm broad, basal mycelia prominent, surface white to off-white and covered by numerous hyphae and fine rhizomorphs. Gleba dark green, the columella cartilaginous-translucent. Peridium 300–400 µm thick, of hyaline to pale yellow, loosely interwoven hyphae 2.2–9 µm broad with cells inflated ≤20 µm, the walls ±1 thick. Trama 40–100 µm thick, of hyaline, chaotically interwoven to subparallel hyphae in a gelatinized matrix, 2–3 µm broad, the walls ±1 µm thick. Basidia cylindrical to subclavate, 7–10 × 25–45 µm, hyaline, 1–3-spored. Spores

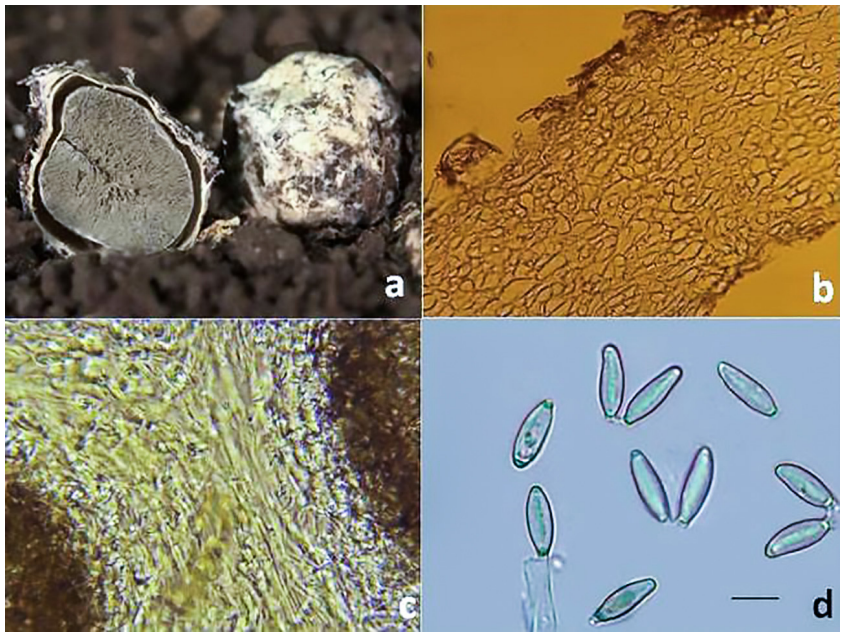

Figure 5. *Hysterangium calcareum* (TARC AT-2176):
a. basidiocarp; b. peridium; c. trama; d. basidiospores. Scale bar = 10 µm.

fusiform, 13.1–16.3 × 4.8–6.3 µm, mean 14.0 × 5.0 µm, the walls ±1 µm thick, hyaline to pale green, smooth, sterigmal appendage 1.5–2.5 × 2.5 µm.

Specimen examined—**TURKEY, Ordu**, Ünye, Çaybaşı, under pure *Fagus orientalis*, 27 Oct 2013, Türkoğlu AT-2176.

Paxillaceae

Melanogaster ambiguus (Vittad.) Tul. & C. Tul. Ann Sci. Nat., Bot., sér. 2 19: 378, 1843. Fig. 6

This specimen was found in tailings of an animal dig, so many morphological diagnostic characteristics were damaged, forcing us to base the description on sub-par material. Remnants of basidiocarp black-brown due to having been bruised, 0.6 × 1 cm. Peridial fragment surfaces irregular with shallow pits. Gleba sterile portions dark brown, locules irregular, black. Peridium 50–220 µm thick, single-layered, of red brown compactly interwoven hyphae 3–6 µm broad, the walls 1 µm thick. Trama 80–120 µm thick, reddish grey, of interwoven hyphae 3–5 µm broad, the walls ±1 µm thick. Basidia not observed.

Figure 6. *Melanogaster ambiguus* (TARC AT-2255):
a. basidiocarp; b. peridium; c. trama; d. basidiospores. Scale bar = 10 µm.

Spores ellipsoid-citriform-papillate, 13–16 × 7–10 µm, mean 14.4 × 9.0 µm, the walls ±1 µm thick, brown, smooth; sterigmal appendage 2.5–3 × 2 µm.

Specimen examined—**TURKEY, Muğla,** Fethiye, Çenger, under mixed stands of *Quercus cerris, Q. pubescens* and *Pinus brutia*, 9 Mar 2014, Todd Elliott AT-2255.

Remarks—*Melanogaster ambiguus* was previously recorded from Hakkari, Turkey, by Uzun et al. (2014)

Melanogaster macrosporus Velen. České Houby 4–5: 808, 1922. Fig. 7

Basidiocarp subglobose to lobate, 1.5 × 2 cm, surface red-brown with dark brown rhizomorphs. Gleba black at maturity with sterile white veins scattered throughout. Peridium 85–315 µm thick, single-layered, of interwoven hyphae 4–12 µm broad, the walls 1–2 µm thick, red-brown on outer portion of peridium becoming hyaline towards gleba. Trama 120–200 µm wide, opaque, of tightly packed, interwoven hyphae 2–5 µm broad in a gelatinous matrix, the walls ±1 µm thick. Basidia not observed. Spores elongate-fusiform, 10–14 × 5–6 µm, mean 11.5 × 5.7 µm, brown, walls 0.5 µm thick, smooth.

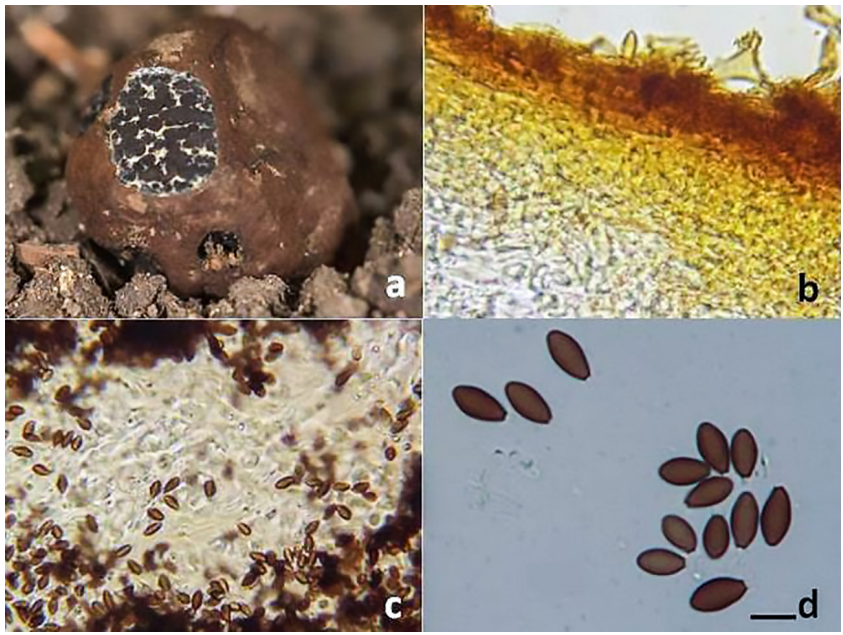

Figure 7. *Melanogaster macrosporus* (TARC AT-2179):
a. basidiocarp; b. peridium; c. trama; d. basidiospores. Scale bar = 10 µm.

Specimen examined—**TURKEY, Trabzon,** Sürmene, Aksu village, under *Fagus orientalis, Picea orientalis, Castanea sativa* and *Rhododendron ponticum*, 27 Oct 2013, Türkoğlu AT-2179.

Sclerogastraceae

Sclerogaster compactus (Tul. & C. Tul.) Sacc. Syll. Fung. 11: 170, 1895. Fig. 8

Basidiocarps subglobose to ellipsoid, ≤0.8 × 1 cm broad, white, becoming yellowish with age, dry, the outer layer frequently peeling in fine fibrils to expose the outer gleba, occasional white rhizomorphs present at base. Gleba yellowish-orange with a white columella ±1 mm broad, with white veins radiating outwards. Odour sweet, pleasant, sometimes cheese-like. Peridium 300–600 µm thick, white in cross section, two-layered, separable, the outer layer 170–480 µm thick, dextrinoid in mass, composed of tightly interwoven hyphae 1–3 µm broad, frequently projecting ≤25 µm from outer peridial wall, the cell walls ±1 µm thick; inner peridial layer 100–250 µm thick, consisting of

tightly interwoven, inamyloid hyphae 2–5 µm broad with walls ±1 µm thick; straight hyphae >200 µm long interspersed throughout the tightly interwoven hyphae, easily observable if the peridium is peeled from the sporocarp, occasional inflated cells 13–27 × 11–12 µm typically present towards the gleba, the cell ±1 µm thick. Trama 18–200 µm broad, of interwoven hyphae 2–3 µm diam with occasional inflated cells ≤9–11 × 11–18 µm, the walls ±1 µm thick. Basidia infrequently visible, cylindric to clavate, ± 5 µm broad at apex and tapering towards base, 2–4 spored, sterigmata ≤3 µm long, ±0.5 µm broad. Spores spherical to ovoid, 5–7 × 4–6 µm, mean 6.2 × 5.2 µm, cyanophilic with lactophenol cotton blue, apiculus ≤1.5 µm broad, ornamentation ± 0.5 µm.

In mixed stands of *Pinus brutia* and *Quercus coccifera* in an area with numerous small animal diggings; small tooth-marks appeared on the peridial surface and into the outer gleba of several fruiting bodies.

Specimens examined—**TURKEY, Muğla**, Datça, 25 Oct 2013, Cansu Korkmaz AT-2223; Köyceğiz, Yuvarlakçay, under *Pinus brutia* and *Quercus coccifera*. 8 Mar 2014, Todd Elliott AT- 2252.

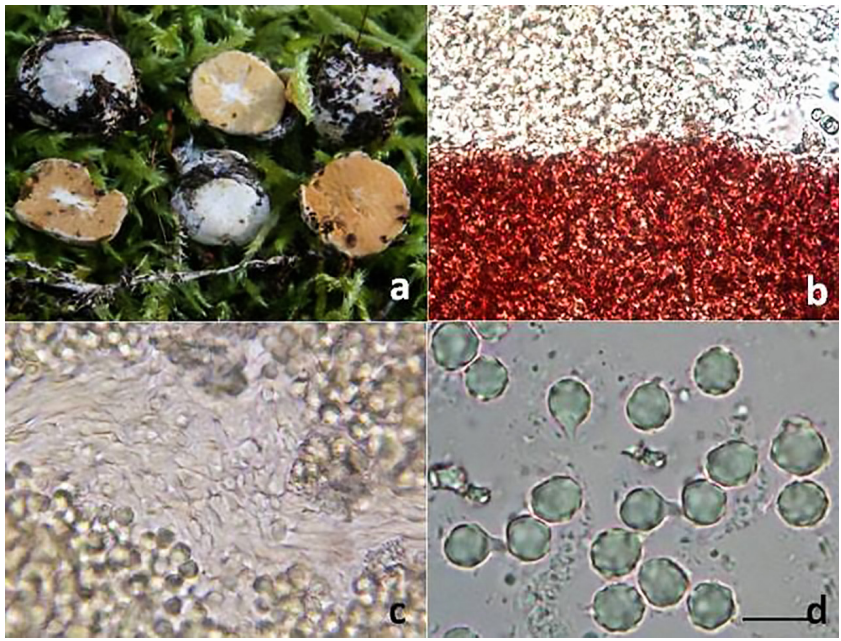

Figure 8. *Sclerogaster compactus* (TARC AT-2252):
a. basidiocarp; b. peridium; c. trama; d. basidiospores. Scale bar = 10 µm.

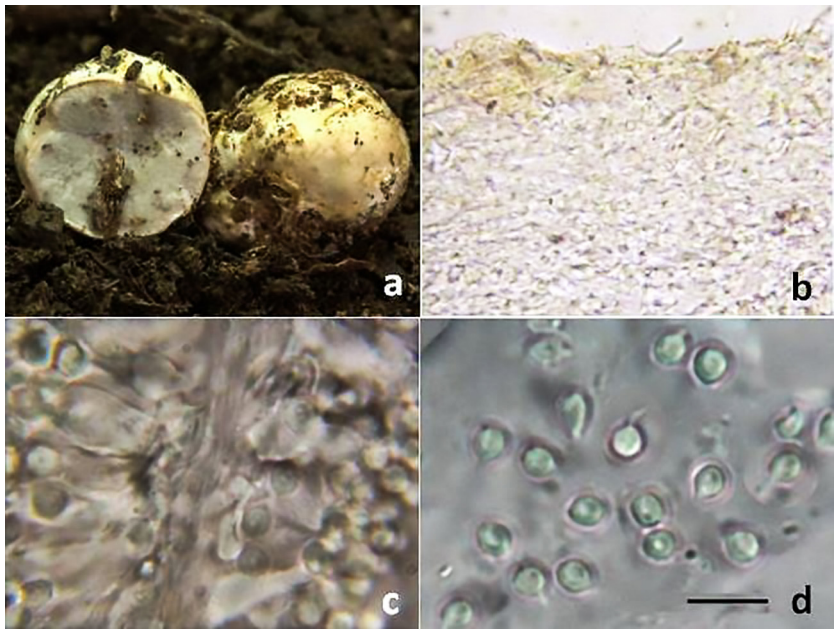

Figure 9. *Sclerogaster hysterangioides* (TARC AT-2187):
a. basidiocarp; b. peridium; c. trama; d. basidiospores. Scale bar = 10 µm.

Sclerogaster hysterangioides (Tul. & C. Tul.) Zeller & C.W. Dodge, Ann. Missouri Bot. Gard 22: 370, 1935. Fig. 9

Basidiocarp globose to subglobose, ≤1 × 1.5 cm, white to off white with some pink patches, different colored hyphae present on outer peridial surface, typically brown on basal portion of fruiting body. Gleba off-white when young, turning grey with maturity, columella present at basal portion, ≤2 mm diam at base and tapering towards the center of fruiting body. Peridium 240–410 µm thick, white in cross section, two layered: outer layer 25–80 µm thick, faintly dextrinoid, parallel to loosely interwoven, hyphae 1–4 µm broad with walls ±1 µm thick; inner layer 215–330 µm thick, densely packed interwoven hyphae 3–7 µm broad, the walls ±1 µm thick, inflated cells 4–22 × 3–12 µm, interspersed with inner peridial hyphae, inflated cells. Trama 9–60 µm thick, of loosely interwoven hyphae 2–4 µm broad, the cell walls ±1 µm thick, the locules irregularly shaped up to 180 µm across, clearly demarcated from trama hyphae, lined with basidia and basidiospores. Columella ≤530 µm diam at basal end and tapering towards glebal center, consisting of hyaline parallel hyphae, 0.5–2 µm broad, with occasional interspersed inflated cells 10–14 × 6–8 µm, the walls ±1 µm thick. Basidia clavate to pyriform, 15–18 × 4–6 µm, basidial

walls ±1 µm thick, 3–4-spored, sterigmata 2–5 × 1 µm, tapering towards apex. Spores spherical to ovoid, 4–5 × 3–4 µm, mean 4.6–3.7 µm, faintly cyanophilic with lactophenol cotton blue, smooth to minutely ornamented, apiculus ≤1.5 µm broad.

Specimen examined—**TURKEY, Bolu**, Mengen, Ahmetler Village, under mixed stands of *Pinus nigra* and *Quercus* sp., 9 Nov 2013, Türkoğlu AT-2187.

Hymenogastraceae

Hymenogaster rehsteineri Bucholtz, Hedwigia 40: 318, 1901. Fig. 10

Basidiocarp globose to irregular, 0.8 × 1 cm, the surface smooth, white at first, darkening with age. Gleba overall white (immature specimen), frequently with darker areas, locules irregular, <0.5 mm broad. Peridium 140–275 µm thick, single-layered, the outer part pale yellowish-brown grading to hyaline towards the gleba, of compact parallel hyphae 3–7 µm broad, the walls ±1 µm thick. Trama 60–100 µm wide, of compact parallel hyphae 1–4 µm broad, the walls ±1 µm thick; subhymenium of indistinguishable interwoven hyphal masses giving rise to basidia. Basidia clavate, 4–6 µm broad at the apex tapering

Figure 10. *Hymenogaster rehsteineri* (TARC AT-2177-a):
a. basidiocarp; b. peridium; c. trama; d. basidiospores. Scale bar = 10 µm.

towards the base, the walls ±1 µm thick, 2–4 spored; sterigmata ± 2 µm long. Spores ellipsoid to fusiform, 15–24 × 7–12 µm including ornamentation, mean 19.9 × 8.0 µm, brown, the surface wrinkled, sterigmal appendage prominent, ±1 µm long.

Specimens examined—**TURKEY, Samsun**: Çarşamba, Köklü village, under *Corylus* sp., 12 Nov 2013, Türkoğlu AT-1600; Türkoğlu AT-1602; Türkoğlu AT-1604; Türkoğlu AT-1608; Türkoğlu AT-1609; Türkoğlu AT-1610. **Artvin**, Arhavi, Arılı, in a mixed stand of *Alnus glutinosa, Fagus orientalis*, *Picea orientalis, Rhododendron ponticum,* and *Salix caprea* 27 Oct 2013 Türkoğlu AT-2177-a. **Yalova,** Güneyköy, under mixed stands of *Fagus orientalis, Quercus petraea*, and *Rhododendron* sp., 21 Nov 2013, Türkoğlu AT-2201. **Tekirdağ,** Saray, Ergene district, under mixed stands of *Carpinus betulus, Pinus nigra,* and *Quercus* sp., 22 Nov 2013, Türkoğlu AT-2210.

Discussion & conclusion

Through this study we have increased the known distribution of ten truffle species as well as provided thorough descriptions of each.

Tuber puberulum is distinguished by its yellow-brown peridium with dermatocystidia and reticulate-alveolate spore ornamentation, contrasting with *Tuber ferrugineum* with a red-brown smooth peridium without regular dermatocystidia and spores ornamented with narrow spines.

Leucophleps aculeatispora has densely ornamented spores with minute spines and is covered with a thin mucilaginous matrix. *Leucophleps aculeatispora* is the only *Leucophleps* species known from Europe, and our material fits the description by Montecchi & Sarasini (2000).

The *Hysterangium calcareum* basidiocarp is covered by mycelium and fine rhizomorphs and produces smaller spores than *H. clathroides.* It appears to be closely associated with *Abies nordmanniana* var. *bornmuelleriana* and *Fagus orientalis* in the Black Sea region.

Sclerogaster compactus has a strongly dextrinoid outer peridial layer composed of tightly interwoven hyphae and large spores in the gleba, whereas *Sclerogaster hysterangioides* has a weakly dextrinoid peridium of parallel to loosely interwoven hyphae and smaller spores.

Melanogaster ambiguus spores are ellipsoid-citriform, papillate, and 13–16 × 7–10 µm, whereas those of *M. macrosporus* are elongate-fusiform, 10–14 × 5–6 µm. *Melanogaster macrosporus* occurs under mixed stands of *Castanea sativa, Fagus orientalis, Picea orientalis,* and *Rhododendron ponticum* in the Black Sea region, whereas *Melanogaster ambiguus* occurs under mixed stands of *Pinus brutia, Quercus cerris*, and *Q. pubescens* in the Mediterranean region.

Our concept of *Hymenogaster rehsteineri* aligns with that of Montecchi & Sarasini (2000). The truffle appears closely associated with *Corylus* spp. and *Fagus* spp. in Europe as well as in Turkey.

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